

## **STATE OF THE WATERSHED REPORT DELTA SUB-WATERSHED**

### **Watershed Description**

The legal boundary of the Sacramento-San Joaquin Delta Estuary is defined in Section 12220 of the Water Code (see attached figure). The area comprises over 700 miles of interconnected waterways and encompasses 1153 square miles (State Land Commission, 1991). Most of the Delta is included in the San Joaquin watershed (See watershed description of the State of the Watershed Report for the San Joaquin River Watershed). However, for simplicity, the Delta is discussed here as a separate unit. The Delta, together with San Francisco Bay, is the largest Estuary on the west coast of North America. Three rivers, the Sacramento, the San Joaquin, and the Mokelumne, with a combined average unimpaired flow of about twenty-two million acre-feet per year, feed it. Major beneficial uses of Delta water are municipal and domestic water supply, irrigation water, water contact recreation and freshwater aquatic habitat. First, the Delta is home to over two hundred and eighty species of birds and more than fifty species of fish (San Francisco Estuary Project, 1992; Herbold and Moyle, 1989) making it one of the most ecologically important aquatic habitats in the State. Second, over half of all the drinking water for the State of California is pumped from the Delta (State Lands Commission, 1991). Protecting Delta beneficial uses is one of the Regional Board's major responsibilities.

Water quality impairments in the Delta can result from either contamination being carried into the Estuary on the main rivers or from *in situ* land and water management practices within the system. Reductions in upstream loads should improve water quality conditions in the Delta for many contaminants. Emphasized in this report are activities that must occur within the Delta to ensure the protection of the Estuary's water quality.

### **Water Quality Assessment**

#### **SURFACE WATER**

There are many reports that describe water quality conditions in the Delta. This report is not intended to be a compilation of all these, but instead is presented to summarize what is known about the most important problems. The most significant surface water quality problems in the Delta are mercury, pesticides, salinity, dissolved oxygen, urban storm runoff, polychlorinated biphenyls (PCBs) and dioxins, MTBE, human pathogens and metals. There is concern that sediment may be toxic in some areas and that dredging activities may result in toxic conditions at disposal sites and in the vicinity of the dredging operations.

**Table DELTA-1. Summarized Central Valley Regional Water Quality Control Board Priorities Based on 1998 Clean Water Act Section 303(d) List for the Sacramento River Basin**

Estimated FYs - TMDL Activities (Excluding Basin Plan Amendment)								
Location	Pollutant	Sources	99/00	00/01	01/02	02/03	03/04	>03/04
High Priority								
Delta Waterways	Hg	MINI	[\$]	[\$]	[\$]	[\$]	X	X
	Diazinon, Chlorpyrifos	AGRI, URBA	[\$]	[\$]	[\$]	[\$]	X	X
	DO	MUNI, URBA	[\$]	[\$]	[\$]	[\$]	X	X
Medium Priority								
Delta Waterways	UTX	UNKN	X	X	X	X	X	X
	EC	AGRI	X	X	X	X	X	X
Five Mile Slough	Diazinon	AGRI, URBA	[\$]	[\$]	[\$]	[\$]	X	X
	Chlorpyrifos	URBA	[\$]	[\$]	[\$]	X	X	X
Mosher Slough	Diazinon	AGRI, URBA	[\$]	[\$]	[\$]	[\$]	X	X
	Chlorpyrifos	URBA	[\$]	[\$]	[\$]	X	X	X
Marsh Creek Reservoir	Hg	MINI	X	X	X	X	X	X
Low Priority								
Delta Waterways	Group A, DDT	AGRI	X	X	X	X	X	X
Marsh Creek	Hg, Metals	MINI	X	X	X	X	X	X

**Pollutants**

DO = Dissolved Oxygen

EC = Electrical Conductivity

Hg = Mercury

Group A = One or more of the Group A pesticides\*

UTX = Unknown Toxicity

**Sources**

AGRI = Agriculture

MINI = Resource Extraction (*All MINI sources are abandoned mines*)

MUNI = Municipal Point Sources

UNKN = Unknown Sources

URBA = Urban runoff/Storm Sewer

**Funding Availability**

\$ = funded

[\$] = partially funded

x = not funded

**Funding estimates do not include funds needed for Basin Plan Amendment process. Estimates based upon current workplans.**

\*Group A pesticides = aldrin, dieldrin, chlordane, endrin, heptachlor, heptachlor epoxide, hexachlorocyclohexane (including lindane), endosulfan, and toxaphene

The entire Delta is on the Clean Water Act Section 303(d) list (water bodies where objectives are not being met even after application of Best Available Treatment/ Best Control Technology) because of elevated fish tissue levels of mercury, Group A Pesticides and DDT (Table Delta 1). Also, the entire Delta is listed for water column toxicity and chlorpyrifos and diazinon. A small area, in the vicinity of Stockton, is listed because of periodic depressed levels of dissolved oxygen. Stockton urban creeks are listed for chlorpyrifos and diazinon. The southern Delta is listed for salt. Marsh Creek is listed for mercury.

There are numerous agencies, Boards, special committees, and groups that have an interest in the Delta and implement programs that influence water quality. Regional Board staff participates on various committees and work groups that address pollutant related issues. The Regional Board does not intend to try to manage the Delta. Instead, the Board intends to remain focused narrowly on pollutants and pollutant related issues. Staff will coordinate closely with the CALFED Bay-Delta Program and the committees formed to guide implementation of the San Francisco Estuary Project's Comprehensive Conservation and Management Plan (CCMP).

## Mercury

There is a human health advisory in effect in the Delta and in San Francisco Bay because of elevated mercury levels in striped bass and other long lived fish (Office of Environmental Health Hazard Assessment (OEHHA)). The Bay and Delta are both on the Clean Water Act Section 303(d) for mercury in fish tissue. Water column mercury levels in the Sacramento River, in Cache Creek and in parts of the Delta exceed US EPA criteria for total mercury during periods of high storm water runoff. CALFED has identified mercury as a pollutant of concern in the Delta and is evaluating various actions to reduce mercury levels. The main sources of mercury to the Delta are streams tributary to the Sacramento River from both the Sierras and Coast range including Cache Creek (see Sacramento River Initial State of Watershed the Report). Discharges from Mt. Diablo Mine to Marsh Creek are another obvious source.

In California, mercury was historically mined in the Coast Range both north and south of San Francisco Bay and transported across the Valley for use in placer gold mining in the Sierra Nevada Mountains. Both operations caused widespread mercury sediment contamination in the watercourses. The limited mercury work undertaken so far in the Central Valley has concentrated on estimating loads to the Estuary and on determining *in situ* mercury bioavailability in valley waterways.

A loading study conducted by Larry Walker Associates (1997) estimated that the Sacramento watershed to the Estuary between October 1994 and September 1995 exported 640 kg of mercury. Most of the material was contributed during winter high flow periods. The Feather River and American River watersheds, sites of intensive historical placer gold mining activity, accounted for only about 25% of the total load. The majority of mercury appeared to originate from the Sacramento River watershed above the confluence of the Feather River. Between 1993 and 1995 the Regional Board conducted a bulk mercury loading study to the Estuary from the Sacramento River watershed. This study differed from that of Larry Walker Associates in that it included an assessment of loads from the Yolo Bypass during high flows. The Regional Board estimated that the Sacramento River watershed exported 800 kg of mercury to the Estuary between May 1994 and April 1995 (Foe and Croyle, 1998). Staff found, like Larry Walker Associates, that most of the mercury was transported into the Estuary during high flow periods. High mercury concentrations in the Yolo Bypass suggested possible local inputs. Follow-up studies demonstrated that Cache Creek was exporting about 1000 kg of mercury during wet years. Half of the load was trapped in the Cache Creek Settling Basin while the remainder was exported to the Bypass.

Additional monitoring conducted in Cache Creek in 1997 and 1998 confirmed that the watershed was a major source of mercury to the estuary. Sulfur Creek and Harley Gulch were identified as significant mercury sources during the wet season while Clear Lake was the major input in the dry irrigation season. Not yet known is the bioavailability of coastal range mercury once transported into the Estuary. However, Cache Creek serves as the major water source for the recently created Yolo Wildlife Refuge Area. In

addition, the CALFED Bay/Delta Program has purchased several large tidal islands downstream in the Yolo Bypass for conversion to shallow water wildlife habitat. These areas are being built upon fill derived, at least in part, from erosion of the Cache Creek watershed.

Slotton, et. al. (1997) studied mercury bioaccumulation in aquatic invertebrate communities in the Sierra Nevada mountains and Coast Range and identified local hot spots of elevated concentrations of bioavailable mercury. All were associated with past intensive gold and mercury mining. The studies also suggest that some sites with large bulk mercury loads, such as Cache Creek drainage, might not be as vulnerable to methyl mercury production as their loads would suggest at least while in the parent watershed. Still unknown is the fate of the material from the various watersheds once transported into the estuary.

#### Current Activities and Strategies to address the problem

The goal for the Delta is to reduce fish mercury tissue concentrations to levels that eliminate the need for fish consumption advisories. Staff has identified the following general process for addressing beneficial use impairments resulting from elevated mercury levels in Delta fish: 1) form a task force to develop a regional mercury strategy, 2) conduct source identification and assessment studies in the Central Valley and San Francisco Bay area, 3) conduct directed research to better understand mercury cycling in the Central Valley and estuary, 4) conduct pilot mercury control projects and evaluate their effectiveness, and 5) develop a plan to implement a mercury control strategy. These general actions are included in the Regional Board draft cleanup plan for the Bay Protection and Toxic Cleanup Program. These actions need to be implemented in a manner that satisfies the requirements for TMDL development and is consistent with the time schedule included in the Clean Water Act 303(d) list adopted by the Regional Board in January 1998. These actions are also consistent with CALFED's Water Quality Component Report.

CALFED and the Sacramento Watershed Programs have funded much of the recommended early phases of the Cache Creek and Bay-Delta estuary control efforts. A summary of what has and has not been funded is provided below.

*Regional Task Force* A regional task force called the Delta Mercury Tributary Council has been formed and presently meets every other month. The taskforce is composed of mercury scientists, staff from Federal, State and County agencies and local landowners. The Sacramento Watershed Program has funded a facilitator and website. Purpose of the Council is to act as a clearing-house for new local information on mercury and as a sounding board for development of the TMDL.

*Source Identification and Assessment:* This task involves two elements, both of which are at least partially underway in the Central Valley and Estuary. First, continue mercury loading and bioavailability studies and, second, conduct fish tissue burden studies to evaluate the public and wildlife risk posed by the elevated mercury concentrations.

CALFED has funded studies to determine inorganic and methyl mercury loads from the San Joaquin and Mokelumne/Cosumnes basins and to estimate *in situ* methyl mercury production from estuarine sediment. The Sacramento Watershed program has funded a study to better quantify loads from the Sacramento Basin. The loading information will be combined into a mercury mass load model for the estuary. Still needed is information on mercury loading from NPDES and urban storm water runoff in both the Central Valley and Delta. Eventually, the State will also need follow up studies to determine the major sources of total and methyl mercury from the primary watersheds contributing most of the bioavailable mercury to the estuary. However, first needed is a prioritization of the relative mass loads. This will be accomplished by completion of the mercury mass load model.

Preliminary water column and aquatic tissue data from the ongoing CALFED grant indicates that the tributaries, particularly the Sacramento Watershed is a major source of both total and bioavailable mercury for the Delta. The data also indicate that the central Delta is a sink for methyl mercury. While the CALFED study will continue for a second year to confirm these patterns, staff believes the data is sufficiently robust to request funds to begin evaluating sources of methyl mercury in the tributary watersheds. Staff is also requesting funds to organize a study and to determine loads of mercury from major NPDES facilities in the Central Valley and Delta.

CALFED has also funded fish tissue studies for Cache Creek and the Bay-Delta. Both years of collection are now complete and a report is being prepared. In addition, DeltaKeeper and the U.S. Geological Survey collected fish tissue samples this past year. These studies have determined that high levels of mercury are present in fish throughout the San Joaquin Basin and in the Sierras. While we suspected that elevated levels would be seen in the Sierra around gold mining areas, we were surprised by the San Joaquin data. It is clear that the spatial magnitude of the mercury contamination problem is more widespread than originally thought. Therefore, funds are being requested for a valley wide joint fish tissue body burden and human fish consumption study. We believe this information is essential to determine the human risk that mercury poses, develop meaningful TMDL targets and prioritize cleanup in the Central Valley and Bay-Delta Estuary.

*Research:* CALFED has funded directed research to better understand mercury cycling in the Bay and Delta. The emphasis of the research is on evaluating the relative bioavailability of the different sources of mercuric material moving into the estuary in comparison with concentrations already present and available in sediment. At a minimum, these will include an evaluation of inputs from the Coast Range and Sierra Nevada Mountains. The studies should also include an evaluation of the importance of the remobilization of mercury from sediment by natural fluxing. Still to be funded is the development of a model to predict bioavailability of mercury loads from the various sources. This model would be used to make recommendations on the amount of load reduction needed from specific sources to meet the TMDL target. Funds are now being requested for development of a fate, transport and bioaccumulation model.

*Pilot Control Strategies:* Once mercury cycling in the Bay and Delta is better understood and the primary sources of bioavailable mercury known, then pilot control studies should be undertaken to ascertain the most practical, cost effective method of minimizing mercury bioaccumulation. The geographic scope of these will be in both the Central Valley, near the source of the parent material, and also in the estuary where much of this material now resides. For the Central Valley these may include runoff and waste material isolation studies, natural revegetation studies, waste rock removal and infiltration evaluations. Cache Creek has been shown to be a major source of mercury to the Yolo Bypass and estuary. The Cache Creek Settling Basin was built to trap sediment eroding from the upstream basin. Funds are requested to evaluate whether the settling basin can be modified to better trap sediment and the associated mercury. Another Central Valley strategy may be to implement a pilot mercury-recycling program to provide for environmentally safe reuse of mercury collected by Sierra gold dredgers. For the Bay-Delta these will initially emphasize determining the mechanisms responsible for the loss of methyl mercury in the Central Delta. Funds are being requested for a multiyear study to determine mechanism(s) with the hope that these can be enhanced to provide natural mercury control. Funds are also requested to evaluate other Delta mercury control actions in fiscal year 02/03.

Ultimately, it is likely that some of the principal sources of bioavailable mercury in the Central Valley will be determined to be from sites where the owners have insufficient resources to carry out the clean up. The State of California has legislation that limits the liability of third parties that would undertake abatement actions at mines. However, at the federal level, there is no such protection for third parties and this is hampering efforts to clean up some sites. The State of California needs to pursue federal “good Samaritan” legislation.

*Implementation Plan:* The Regional Board committed to U.S. EPA to deliver a technical TMDL for the control of mercury in the estuary by June 2003. The goal of the plan will be to reduce mercury tissue levels in Bay/Delta fish to levels that allow elimination of consumer advisories. The plan should include load reduction goals from the principal sources that contribute to elevated mercury levels in fish and other management measures to reduce fish uptake. Shortly thereafter Regional Board staff will begin preparation of a basin plan amendment for control of mercury in the estuary. The Basin plan amendment will be based upon the technical TMDL but will include a monitoring plan to assess compliance, a time schedule and an implementation plan. Recommendations will also be provided on how to fund implementation

### Pesticides

*Water Column Pesticide Problems:* Aquatic resources in the Delta are in decline (Herbold et al. 1992). Many factors have been advanced to explain the collapse including water diversions, loss of habitat and toxic chemicals. The role of toxic chemicals in this collapse has been the subject of three recent review papers (Bailey et. al., 1995; Fox and Archibald, 1995; Foe, 1995). All three concluded that pesticide concentrations in the

Delta are periodically at concentrations that should be toxic to sensitive local organisms. However, the significance of pesticides on the decrease in abundance and distribution of local organisms is not known.

The Bay Protection Toxic Cleanup Program (BPTCP) began in 1992 to identify locations in the Estuary where contaminant levels in water or sediment were sufficiently elevated to kill aquatic organisms (including bioassays) and where chemicals were identified at concentrations explaining the toxicity. BPTCP funds were used in the Delta to evaluate water column toxicity employing the US EPA three species bioassay procedure (EPA, 1989). Toxicity has been observed to all three species (fish, invertebrate, and alga). However, the chemical responsible for toxicity has only been routinely evaluated for the invertebrate species. This was because limited funds existed and acute toxicity was frequently observed with this species. In each case insecticides (primarily diazinon, chlorpyrifos, and carbofuran) were identified through a combination of chemical analysis and Toxicity Identification Evaluations (TIEs) as the cause of toxicity (Deanovic, et. al., 1996, 1998). On some occasions the chemicals were transported into the Estuary on the major rivers and in other cases they were discharged into back sloughs from use within the Delta. An example of a riverine input is the movement of the dormant orchard spray diazinon into the estuary in storm runoff from both the Sacramento and San Joaquin basins (Foe and Sheipline, 1993; Kuivila and Foe, 1995). An example of input within the Delta is the presence in March and April of carbofuran and chlorpyrifos at toxic concentrations in back sloughs from applications to control alfalfa weevils (Foe and Sheipline, 1993; Bailey personal communication). Another example is the toxicity in back sloughs associated with urban runoff from Stockton. A combination of bioassay, chemical and toxicity work has demonstrated that diazinon and chlorpyrifos are present in urban runoff discharged to back sloughs around Stockton at concentrations toxic to sensitive invertebrate species (Connor, 1994, 1995). Toxicity to the algal bioassay organism has also been measured in the Delta and diuron has been implicated as the cause of some of the toxicity. However, in most cases the chemical cause is not known, although Phase I TIEs suggest nonpolar organics (Bailey, personal communication). Finally, fish toxicity has been detected in Sacramento River water at its confluence with the Delta and at various points in the Estuary. The cause of the fish toxicity is not known.

The entire Delta and Stockton area urban creeks are on the Clean Water Act 303(d) list for diazinon and chlorpyrifos. CALFED has identified diazinon, chlorpyrifos, and carbofuran as pollutants of concern in the Delta and is evaluating various actions to reduce levels of these pesticides.

#### Current Activities and Strategies to address the problem

Pesticides have been identified in the BPTCP as a significant source of toxicity to the invertebrate and algal component of the EPA three species bioassay procedure. Carbaryl, diazinon, carbofuran and chlorpyrifos have been identified as the cause of invertebrate toxicity but other chemicals also contribute. Diuron has been implicated as a cause of algal toxicity in a few instances, but in most cases the cause of the impairment is not

known. Finally, several different monitoring groups in Sacramento River water entering the Delta have observed toxicity to the fish component of the tests but the chemical was not identified.

*Chlorpyrifos and Diazinon:* As previously mentioned, the Delta and several tributaries are included on the Clean Water Act 303(d) list for chlorpyrifos and diazinon (see Section 9 in Appendix A for more information). In addition, the Regional Board has adopted a draft cleanup plan for chlorpyrifos and diazinon in the Delta (see Bay Protection and Toxic Cleanup Program description). Actions to address problems associated with chlorpyrifos and diazinon need to be consistent with these two programs and the MAA.

The most significant sources of chlorpyrifos and diazinon are winter storm runoff from orchards, summer irrigation return flows and urban runoff. The general actions that are required to resolve water quality problems associated with these two pesticides include (1) establishment of interim and long term water quality goals, (2) development of management practices that can be implemented to meet the targets, (3) development of cost estimates to implement the practices, (4) completion of studies to determine potential ecological significance of these pesticides in the Delta and tributaries, (5) establishment of mechanisms for assuring implementation of management practices, and (6) implementation of a monitoring program to measure compliance with water quality objectives. The actions need to be implemented in the Delta and the tributaries to the Delta, since a major source of these pesticides is upstream from the Delta. Actions need to be implemented in a manner that takes into consideration the inherent differences in the watersheds. The general actions are included in the Regional Board draft cleanup plans for the Bay Protection and Toxic Cleanup Program. These actions can be implemented in a manner that satisfies the requirements for TMDL development and is consistent with the time schedule included in the 303(d) list adopted by the Regional Board in January 1998.

For the agricultural pesticide component, there are numerous efforts underway to develop practices that can be implemented to reduce the amount of pesticides entering surface waters. DPR is investigating orchard floor management as a means to reduce discharges of dormant sprays into surface waters. Also, at California State University at Fresno, DPR is investigating the effects of microbial augmentation and post application tillage on runoff of dormant sprays. Dow Elanco and Novartis, the registrants of chlorpyrifos and diazinon, have undertaken a multiyear study in Orestimba Creek in the San Joaquin Basin with the primary objective of identifying specific agricultural use patterns and practices which contribute the bulk of the off-site movement into surface water. The Biologically Integrated Orchard Systems (BIOS) program has received a series of grants from the State and US EPA to implement community based efforts to implement economically viable, non-conventional, pest management practices. Colusa County Resource Conservation District is leading a runoff management project, funded through a Clean Water Act Section 319 Grant, to identify management practices that reduce runoff from almond orchards and thereby reduce pesticide loads to local creeks. The Glenn County Department of Agriculture is organizing local growers and PCAs to address the use of

dormant spray insecticides in the county. The Biologically Integrated Prune Systems program is a community-based project that supports implementation of reduced risk pest management strategies in prune orchards. A similar effort is underway for peach orchards. The UC Statewide Integrated Pest Management Project has a SWRCB grant to identify alternative orchard management practices to prevent or reduce off site movement of dormant sprays, provide outreach and education and initiate monitoring to assess success of new practices. In addition, UC was awarded a three year one million dollar grant by CALFED to identify urban and agricultural practices to prevent and reduce off site movement of diazinon and chlorpyrifos into surface water. The CALFED study will consider both urban and agricultural stormwater runoff and summer irrigation runoff.

For controlling urban sources of pesticides, the Regional Board is implementing the NPDES Storm Water Program. This program is further described under the section heading "Storm Water". In addition to this regulatory effort, interested parties in the Bay Area and Central Valley formed an Urban Pesticide Committee to provide a forum for information exchange, coordination and collaboration on the development and implementation of an urban pesticide control strategy. The Committee has developed a strategy that includes a framework of roles and responsibilities that can be taken by various agencies to reduce pesticides from urban sources. CALFED has earmarked resources to develop management approaches that can be implemented to reduce discharges of pesticides from urban areas. Studies are authorized for the Sacramento urban area and in Suisun Bay.

There are studies underway and planned to try to assess the impact of diazinon, chlorpyrifos and other pesticides on local aquatic communities. The emphasis of these studies will be on the Delta and principle tributaries to the Delta. A study is underway to conduct bioassays with local species exposed to water collected from Suisun Bay. CALFED has supported a study by UC Davis to evaluate contaminant effects on Delta smelt. CALFED has also supported implementation of a toxicity testing program in the Delta that includes identification of responsible contaminants. In addition, CALFED has proposed to fund studies to evaluate the ecological effects of diazinon and chlorpyrifos and other pesticides on Delta aquatic species. Finally, CALFED has proposed to fund studies by the Department of Fish and Game that are needed to complete draft criteria reports for the two pesticides.

Over the next several years, staff will continue to work with DPR and other stakeholders to ensure that management practices are developed and implemented to reduce chlorpyrifos and diazinon concentrations in surface waters. In FY 97-98, staff worked with DPR, registrants and other stakeholders to coordinate studies and discuss results. Staff worked with DPR to develop draft cleanup plans for chlorpyrifos and diazinon. Staff coordinated closely with CALFED to evaluate and refine proposals to support efforts to develop management practices to reduce the discharge of pesticides and to study the ecological significance of measured pesticide levels on local aquatic communities. In FY 98-99, staff will finalize the cleanup plan and assist State Board in preparation of a consolidated cleanup plan that will be submitted to the legislature in June 1999. In addition, staff will continue to work with DPR and stakeholders to assure that

the funded work to develop management practices and to determine ecological significance proceeds and that progress is being made toward implementation of practices. In FY 99-2000, staff will continue to work with DPR and stakeholders to assure that progress is continuing according to schedules developed in the cleanup plan and the schedule included in the Clean Water Act 303(d) list for TMDL development.

CALFED and other agencies are providing resources to develop management practices, to evaluate the ecological significance of pesticides in the Delta and to monitor for toxicity and pesticides. There are inadequate resources to fully evaluate program effectiveness and to work with stakeholders to develop reasonable solutions to the problems.

*Other Pesticides:* Additional work is needed in the Delta to ensure that all the primary chemicals causing toxicity are identified. Previous toxicity studies have identified other pesticides as causing toxicity and there are many instances where toxicity exists and the toxicant has not been identified. Staff needs to coordinate these efforts with DPR and stakeholders.

#### *Fish Tissue Pesticide Problems*

The Toxic Substances Monitoring Program has found elevated levels of Group A Pesticides and DDT in fish tissue collected from Hood on the Sacramento River and from Vernalis on the San Joaquin River. The sources of the chemicals are believed to be from past agricultural use and, in the case of chlordane, from urban use. The use of chlordane, DDT, and toxaphene is now banned and endosulfan use is closely regulated and much reduced. DeltaKeeper and the Regional Board conducted a joint study of organochlorine pesticide concentrations in sportfish in the San Joaquin Basin and Delta in 1998. Concentrations of DDT exceeded the U.S. EPA screening value in 23% of the samples. All of the samples above the screening value were obtained from the South Delta or lower San Joaquin watershed. The results of this study are consistent with historic data from the TSMP and data from USGS studies indicating that the south Delta and lower San Joaquin watershed are areas with particularly high organochlorine pesticide concentrations. However, overall organochlorine pesticide concentrations have declined considerably since the late 1970's and early 1980's.

There are several other organochlorine pesticides of potential concern in the Delta. Dieldrin exceeded the screening value in one sample. Data were inconclusive for toxaphene. Additional sampling with a lower detection limit is needed to determine whether toxaphene concentrations in Delta fish exceed the screening level. The data indicate that the following pesticides do not represent a potential human health concern in fish tissue: chlordane, endosulfan, endrin, hexachlorobenzene, lindane, mirex, diazinon and chlorpyrifos.

## Current Activities and Strategies to address the problem

*Fish Tissue Problems:* The principal sources of Group A pesticides (toxaphene, chlordane, endosulfan and a few other pesticides) and DDT are sediment from Colusa Basin Drain in the lower Sacramento River watershed and a series of small westside agricultural drainages in the lower San Joaquin River watershed. Most of the 303(d) listings for pesticides in fish tissue are based on data collected prior to 1985. Some of the listings are based on relatively few samples. The DeltaKeeper study suggest that it may be possible to delist all Group A pesticides in the Delta with the exception of DDT and possibly toxaphene. To delist the Regional Board will need two more years worth of fish tissue data from the Delta. Extensive fish tissue samples have been collected as part of the CALFED mercury project. All these samples have been archived in a manner appropriate for organochlorine pesticide analysis. Funds are requested to perform these analyses, write up the results and evaluate whether delisting of some or all chemicals are warranted

## Dissolved Oxygen

In January 1998 the Regional Board adopted a revised CWA 303(d) list, which identified low dissolved oxygen in the lower San Joaquin River ("Delta Waterways") near Stockton (Figure 1) as a high priority impairment. A plan for increasing dissolved oxygen to levels that meet the Basin Plan water quality objectives in the lower San Joaquin River was outlined in the Regional Toxic Hot Spot Cleanup Plan (Cleanup Plan). The Regional Board approved the Cleanup Plan in June 1999 and by the Office of Administrative Law in November 1999 (CVRWQCB 1999). The main elements of the Cleanup Plan have been initiated including organization and regularly held meetings of Steering and Technical Advisory Committees, initiation of studies to identify major sources of oxygen demand constituents and evaluation of engineering alternatives to increase dissolved oxygen at critical times and locations in the river.

Low dissolved oxygen typically develops as a local depression in the San Joaquin River Deep Water Ship Channel between the Turning Basin and Turner Cut in late summer and often persists through October. Dissolved oxygen concentrations begin to increase in late fall and winter when cooler water temperature increases oxygen saturation potential and increased river flow decreases hydraulic residence time. A smaller magnitude dissolved oxygen depression occurs sometimes during the spring. Dissolved oxygen concentrations are usually lower in areas where there is little flow-through such as the Turning Basin eastward to Weber Point and dead-end water-bodies such as Smith Canal. In the main stem river, low dissolved oxygen conditions usually occur off the western end of Rough and Ready Island but under certain conditions the depression may extend seaward toward Turner Cut and sometimes as far as Disappointment Slough. The low dissolved oxygen levels are thought to stress and kill local aquatic organisms and may prohibit the upstream fall run spawning migration of Chinook salmon.

Studies are underway for identifying sources and their relative magnitudes and determining feasibility of engineering alternatives. Several preliminary studies were

conducted in the summer and fall of 1999, the major findings of which were incorporated into a draft dissolved oxygen TMDL “issues” report. The principal 1999 findings were that fairly continuous violations of the dissolved oxygen objectives were observed between August and November. Oxygen concentrations ranged between 4 and 7 mg/l in August and September but fell to a low of 1.9 mg/l in early October at the Department of Water Resources continuous dissolved oxygen meter off Rough and Ready Island. Seventy-five to eighty-five percent of the load of oxygen requiring substances came from the San Joaquin watershed upstream of Vernalis. Presumably the major upstream sources were from the discharge of BOD and other nitrogenous wastes by agriculture and publicly owned sewage treatment plants and growth of algae in the San Joaquin River. The City of Stockton and other local deep-water ship channel inputs accounted for 8 to 11 percent of the load. The unassimilated load (amount required to be eliminated to correct the oxygen deficit) was estimated at 8,000 to 42,000 pounds of oxygen per day.

In early October the flow of the San Joaquin River decreased at the City of Stockton from about 900 to 150 CFS. The decrease was caused by changes in the operation of the barriers in the South Delta allowing more of the San Joaquin to flow down Old River to the State and Federal pumps at Tracy. As a result the hydraulic residence time--and the amount of time material had to oxidize in the deep-water ship channel--increased from 10 to 25 days. Dissolved oxygen concentrations immediately fell to 1.9 mg/l, the low of the year. At October low flows, the City of Stockton and other local inputs accounted for about 50 percent of the load. About 30 percent of this load was from the release of ammonia by the Cities wastewater treatment plant. A major challenge of the final TMDL control program will be to develop a cost effective, equitable allocation of loads to correct the low dissolved oxygen problem without having any control of the San Joaquin River and the source of the dissolved oxygen constituents.

The Steering Committee secured an \$860,000 grant from CALFED to continue research during the summer of 2000. Major emphasis is to again determine the sources and unassimilated loads of oxygen requiring substances in the deep water ship channel. In addition, the grant will begin to evaluate the sources of oxygen requiring substances upstream of Vernalis and management options to correct the dissolved oxygen problem.

#### Current Activities and Strategies to address the problem

The Steering Committee applied for a second CALFED grant to continue to conduct research on the causes and most cost effective solutions to solving the dissolved oxygen problem. Unfortunately, the grant was not recommended for funding. The Steering Committee intends to appeal the loss of funding to the Bay-Delta Advisory Council in the hope of securing directed action funding. In the interim, the key elements of the proposal are listed below, as collection of this information will be necessary to satisfactorily complete the TMDL. Money is being requested for projects in the San Joaquin basin and deepwater ship channel. For the deepwater ship channel, funds are needed to collect additional field data to refine and validate the Chen dissolved oxygen model. This data is best collected by installation of a series of remote dissolved oxygen and chlorophyll sensors and validating their readings with weekly cruises along the 15-mile length of

channel. The City of Stockton has committed to co-share the cost of the field monitoring up to \$50,000 per year. Funding will also need to be secured to begin to evaluate control measures within the Delta. The two primary control measures being evaluated are the cost and feasibility of increasing aeration in the deepwater ship channel and the installation of high volume low head pumps at the barrier at the head of Old River. Funding is also needed to continue using the services of a facilitator for Steering Committee meetings.

Funding will also be needed for research in the upper San Joaquin Basin as the studies conducted in 1999 found that the San Joaquin was under some circumstances the source of up to 75 percent of the load of oxygen requiring substances. Money is needed to determine the source and magnitude of the upstream nutrients, develop a model that converts these loads of nitrogen and phosphorus into algae, compile a list of possible BMPs for nonpoint source users to employ to reduce loads and fund development of an implementation plan.

### Urban Pesticides

The Regional Board received an US EPA 104(b)(3) grant to identify the pollutants causing toxicity in wet weather urban runoff from back sloughs around the City of Stockton. Testing in 1994 identified toxicity to each of the three species. Diazinon and chlorpyrifos were implicated by both TIE and chemical analysis as the primary cause of invertebrate bioassay mortality. Studies in subsequent years, as part of the BPTCP, confirmed the presence of these pesticides in urban runoff and back sloughs at concentrations that are toxic to sensitive invertebrates. Diuron was identified as a cause of algal toxicity. There were many instances where toxic conditions were measured but no specific toxicant was identified.

Fish kills are reported each year in channels around Stockton after the first large storm of the year. In 1994 U.C. Davis observed high BODs in water collected from Smith Canal, the Calaveras River, Mosher Slough and 5 Mile slough. Ambient dissolved oxygen levels were less than 1 mg/l (the Basin Plan objective is 5 mg/l or 6 mg/l depending on the location) in all the waterways after the first major storm of the year (Connor in prep). Experiments in the lab suggested that the cause of the fish kills was asphyxiation. In 1995 staff observed low dissolved oxygen associated with fish kills after the first storm of the year. In 1996 and again in 1997 DeltaKeeper reported low dissolved oxygen levels in all four waterways. Little suppression in dissolved oxygen has ever been noted in any storm runoff event after the first flush.

Potential problems exist in the vicinity of other urban areas in the Delta (e.g., near Antioch). Also, of concern is the residential growth in both the southern and eastern portions of the Delta, (San Joaquin County and Contra Costa County).

### Current Activities and Strategies to address the problem

*Stockton Urban Area:* The organophosphate insecticides chlorpyrifos and diazinon have been observed in City of Stockton runoff at concentrations causing bioassay toxicity in back sloughs. Algal toxicity from diuron has also been observed. Similar water quality problems have been observed in City of Sacramento runoff suggesting that these pesticides are regional concerns. The City of Stockton presently has an urban runoff monitoring program to confirm these results. It is proposed that follow-up occur after the City of Stockton completes its study, including definition of the causes of toxicity in urban runoff.

Fish kills from low dissolved oxygen levels appear to be a regular occurrence in several Stockton back sloughs including Smith Canal, Mosher Slough, 5-Mile Slough and Calaveras River. Fish kills are associated with the first rainfall runoff of the year. Problems in Smith Canal have been documented every year since 1994. The City of Stockton has agreed to conduct a monitoring study in Smith Canal to verify that low dissolved oxygen levels were associated with storm runoff and to determine the temporal and spatial extent of the impairment and ascertain the constituents in stormwater that cause dissolved oxygen depletion. A final report is expected in summer 1998. If the study is unsuccessful in ascertaining the constituents responsible for the high oxygen demand, then it should be repeated with the purpose of identifying the causes. If the study is successful then three follow-up actions are recommended. First, repeat the Smith Canal study in the other urban sloughs to confirm that the same constituents are responsible for the oxygen deficit in all waterways. Second, conduct a study at Smith Canal to evaluate control options to reduce the input of material with high oxygen demand. Finally, a plan should be submitted to the Regional Board describing how the preferred control options will be implemented throughout the storm water district.

*Southern and Eastern Delta Urban Areas:* There is considerable residential growth along waterways in both the southern and eastern portions of the Delta (San Joaquin and Contra Costa Counties). With proper planning, problems associated with urban runoff can be avoided. Identification of the responsible toxic chemicals is an essential first step in the development of control strategies to reduce toxicity. For example, if toxicity from oil and grease or metals is occurring, then the fix may involve the construction of holding basins. These are most economically built during the initial development of the urban area. Construction later is prohibitively expensive. Holding basins may also ameliorate oxygen deficit problems. On the other hand, little pesticide removal is likely to occur in settling basins. Outreach and public education programs may be more successful here. Therefore, Board staff believes that identification of the cause of toxicity in urban runoff within the Delta should be a high priority concern.

### Salinity

The seasonal pattern of salinity is important to the Delta ecosystem. Elevated salinity also impairs agricultural water uses. The main sources of salt to the Delta are from the San Joaquin River and from oceanic intrusion of saltwater. In the past conditions have not been optimum for protection of agricultural and aquatic life beneficial uses. The

State Board adopted a Water Quality Control Plan for the San Francisco Bay/Sacramento-San Joaquin Delta Estuary in May 1995 prescribing salinity standards within the Delta and is currently developing an implementation plan to achieve compliance with the standards. Staff needs to develop a program to reduce levels of salt entering the Delta from the San Joaquin River and assure continued low salinity in the Sacramento River (see San Joaquin River State of Watershed the Report).

#### Current Activities and Strategies to address the problem

The State Board is addressing salinity in the Delta. The Regional Board is initiating a program to reduce salt inputs to the Delta from the San Joaquin River (see San Joaquin River Initial State of the Watershed Report).

#### Ballast Water Discharge

Ocean going vessels discharge ballast water in the Delta as they navigate through the waterways on their way to unload cargo. The ballast water may contain salt, oil and grease, heavy metals, pathogens from on-board sewage, and foreign aquatic species that could adversely compete with native species. The Bay/Delta system is recognized as the most invaded aquatic ecosystem in North America, with more than 200 introduced invertebrates, fish, plants and microorganisms. The introduction of nonindigenous species has been identified as a critical factor affecting the aquatic life beneficial uses of the Bay/Delta system. Ballast discharges are uncontrolled and the Regional Board has little direct authority over the discharges.

#### Current Activities and Strategies to address the problem

Ballast water discharges have greatly impacted the Bay/Delta system. Introduced species have widespread impacts on native species and threaten the integrity of the aquatic ecosystem. In addition, ballast water may contain salt, oil and grease, heavy metals and pathogens. CALFED has directed resources to start to address the introduced species component of ballast water. Much more research and study will be required to develop workable solutions to this part of the problem. Research is also needed to determine how severe the water quality impacts are from the other contaminants in ballast water. The Regional Board and Fish and Game need to get together with the shipping lines, Coast Guard and Ports to develop a plan to minimize any impacts and, if necessary, to work to develop policies and regulations to control the discharges. This work is not funded.

#### Vessel Sewage Discharges

There are thousands of boats in the Delta used both recreationally and for permanent residences. Raw and partially treated sewage is dumped into Delta waterways from many of these boats. Sewage pump out facilities are available at several locations, but are not used by all boaters. Many vessels used for permanent residences cannot move, so can not use pump out facilities

### Current Activities and Strategies to address the problem

Staff is participating on a limited basis with the Coast Guard and a local agency Task Force to study and eliminate the discharges, but resources of the Regional Board and other agencies are inadequate to properly address the issue. The issue may become much more prominent if the Regional Board places the Delta on the 303(d) list as impaired because of high pathogen concentrations.

### *Abandoned Vessels*

There are many derelict and abandoned vessels in the Delta,. The boats contain fuels and other chemicals that can contaminate surface waters and are a navigation hazard. Abandoned boats are often used as shelter for the homeless, but no sewage facilities are available, so sewage is discharged to the waterways. Abandoned vessels have also been used for drug labs, with toxic chemicals being left on the boats or dumped overboard.

### Current Activities and Strategies to address the problem

The Regional Board has no resources to evaluate or respond to this water quality threat beyond some limited participation in an inter-agency task force

### *Dioxins and Polychlorinated Biphenyls (PCBs)*

The San Francisco Regional Monitoring program demonstrated in 1993 and 1994 that dioxin and total PCB concentrations were above US EPA recommended criteria to protect human health at all sites surveyed in San Francisco Bay including the confluence of the Sacramento and San Joaquin Rivers in the Delta. Furthermore, clam transplant studies demonstrated that some of the highest total PCB tissue concentrations were obtained from animals located in both Rivers. The data was interpreted to mean that the Rivers were a major source of PCBs to the Delta. Not known is the impact of elevated PCB levels on aquatic biota in the Estuary.

In 1998 the Central Valley Regional Board and DeltaKeeper collected fish from the San Joaquin Basin and Delta for PCB analysis. The Sacramento River Watershed Program has also been collecting fish for analysis. No dioxin work has been done in the basin because of the high cost of dioxin analysis. Concentrations of PCB's above the U.S. EPA screening level were frequently detected. Thirty percent of the largemouth bass and white catfish in the DeltaKeeper study were above the screening value (6 of 11 catfish and 3 of 19 largemouth bass). Data from this study and the SRWP suggest that PCBs are elevated in localized hot spots rather than on a regional basis. Smith Canal particularly stood out in this study with high PCB concentrations in both white catfish and largemouth bass. The Port of Stockton also had relatively high PCB concentrations in the two fish species and in Corbicula. PCB congener profiles ("fingerprints") indicate the presence of varying sources at different locations: Aroclor 1260 in Smith Canal, Arochlors 1248 and 1254 at Stockton, and Aroclor 1262 at the Stanislaus River. The limited long-term data for the Delta suggest declines in PCB concentrations, but

concentrations in a few locations remain high relative to historical results and above human health screening values.

The source of the elevated PCB levels in the Stockton Deepwater ship channel has been traced to McCormick and Baxter Creosoting Company located immediately upstream of the Port. The facility has been designated a U.S. EPA Superfund site and a County health advisory issued warning anglers to limit consumption of locally caught fish.

#### Current Activities and Strategies to address the problem

Follow-up studies need to be coordinated with the San Francisco Bay Regional Board to confirm the spatial and temporal extent of the exceedance of US EPA recommended criteria for dioxins and PCBs in the Sacramento and San Joaquin Rivers and Delta. This work is probably best carried out by conducting a comprehensive fish tissue contamination study. For PCB's the goal should be to verify that the Regional Board has identified all local hot spots and that remediation work is underway in each of these. For dioxins the goal should be the first comprehensive tissue evaluation in the basin. The valley wide fish body burden study should be coupled with a comprehensive fish consumption study to determine the magnitude of the problem and the local populations most at risk. This information can be used to help prioritize cleanup, post fish consumption advisories and outreach to specific populations advising them of the associated health risks.

#### Metals

San Francisco Bay exceeds Basin Plan water quality objectives for copper. Estuarine loading estimates suggest that more than half of all the copper load to the Bay is from river inputs. Most of the copper in the Central Valley is thought to originate from mine runoff. An additional metal concern is that metal loads entering the Delta may accumulate to toxic levels in the sediment.

#### Current Activities and Strategies to address the problem

Recent and ongoing mine abatement work at a few sites in the lower Sacramento River watershed and upstream should significantly decrease metal loads to the Delta. Continued metal monitoring is needed to demonstrate that metal loads are decreasing. Much of this work is presently being done by the Sacramento Ambient Monitoring Program (see Sacramento River Initial State of Watershed the Report). Other mines in the watersheds tributary to the Delta contribute to loads of metals entering the Delta. A review of the existing abandoned mine ranking is required to address the potential impact to surface waters from discharges from mine tailings, waste rock and overburden and open pits. The present list is based on the direct discharge of mine drainage from portals and large seeps. Wet weather and storm events can cause significant runoff of mine waste directly into wetland areas and surface waters. The best approach would be to use a watershed coordination committee to reassess the existing ranking and assist the Regional Board in developing a multi-stakeholder approach to addressing high priority

mine sites. This approach will address point source and nonpoint source discharges from mine sites, funding alternatives, and mitigation technology issues. The program needs to include coordinating with other agencies and stakeholders, developing a revised priority list, conducting site assessments at high priority sites, and developing alternatives for funding abatement projects.

### Sediment

Various areas of the Delta contain sediments that may be toxic to aquatic life. These areas appear to be associated with industrial dischargers and spills. In addition, dredging and dredge material disposal activities in the Delta have the potential to cause water quality problems. These activities must, however, take place to maintain two deep-water ship channels and over 1,000 miles of levees. Dredging activities are also performed to improve water conveyance systems and intake structures. Water quality impacts can occur at the dredge site and at the site of disposal or reuse. Contaminants and chemical changes in the material can threaten both ground water and surface water quality. The reuse of dredge material for construction of wetlands, enhancement of channel islands, and the rehabilitation of levees is being considered. To a smaller degree, dredging has been used to mitigate potential toxic hot spots. Sediment quality criteria for the various types of reuses and disposal environments are required to ensure that water quality and beneficial uses are protected.

### Current Activities and Strategies to address the problem

Basic scientific knowledge of safe levels for sediment pollutants to protect surface and ground water quality and biologic communities is generally lacking for dredging and dredge disposal/reuse. Dredging will continue for channel maintenance and new construction. Increasingly, however, dredge material is seen as a source of material for levee maintenance and habitat development. There is great need for large volumes of low cost material to improve Delta levees and dredge material is a potential source. Large volumes of dredge material may be available from the San Francisco Bay area, but the surface and ground water impacts of the salt in saline dredge material is unknown and must be quantified. The Regional Board is working with other agencies, including CALFED and the Department of Water Resources, to develop funding and studies to address these issues. Additional pilot studies may be implemented to clarify technical issues. Eventually General Waste Discharge Requirements will be adopted to address these issues and streamline project review and approval. Any policy or waste discharge requirement adoption requires CEQA compliance and potentially adoption of an EIR. Staff is in the process of collecting the technical information needed to develop an EIR for a general order WDR.

Several large dredging projects with the potential for sediment reuse are being considered (Baldwin Ship Channel and Sacramento and Stockton Deep Water Ship Channels and the Interim South Delta Project). Small-scale demonstration projects have been completed in an attempt to address a number of issues. However, not enough information has been provided to fully evaluate the potential impacts. Staff will work with dischargers,

reclamation districts and agencies to streamline the permitting process for these projects. A key component will be development of generic sediment criteria for various material reuse scenarios. Staff is working with CALFED to direct resources to addressing sediment reuse issues in the Delta.

### Sediment Objectives

Staff has developed interim screening values and test methods to use in current dredging permits. An approach for more in depth analysis has been determined and the collection of information has begun. Working in conjunction with Delta Protection commission and Department of Fish and Game, staff is analyzing past sediment data to determine constituents of concern, potential exposure pathways and scientifically valid test methods and screening criteria. Staff is working with CALFED to propose pilot projects to assess longterm impacts from dredge material reuse. The current focus is on reuse in an upland environment. Additional resources would be necessary to address wetland or aquatic habitat enhancement using dredge material.

The short term goal is to provide technical analysis to be used for an EIR for General Orders for dredging. This would streamline the process for permits for small dredge projects. As part of the CALFED task force, we will work with the Delta Protection Commission and Fish and Game to produce a document to lay out a strategy for developing a dredge material management plan (DMMP) that could be adopted as a basin plan amendment. The DMMP will lay out a decision-making framework, including test methods and screening values, for dredging projects and dredge material reuse. Two staff people are needed to develop the General Orders and begin work on the DMMP as a Basin Plan amendment. An Additional staff person is needed to address the technical issues regarding saline dredge material and write WDRs for pilot studies.

## **GROUND WATER**

### Drinking Water

Various areas of the Delta contain ground water that does not meet drinking water standards. The accedence's appear to result from natural causes and from inputs of pollutants from a variety of point and nonpoint sources, including agricultural operations, underground and above ground tanks, industrial facilities, commercial facilities, military facilities, landfills, waste management units and other spills and leaks. As in the other watershed in the Region, MTBE in groundwater is a concern in the Delta.

### Current Activities and Strategy to address the problem

There are numerous agencies, Boards, special committees, and groups that have an interest in the Delta and implement programs that influence water quality. Regional Board staff participates on various committees and work groups that address pollutant related issues. The Regional Board does not intend to try to manage the Delta. Instead, the Board intends to remain focused narrowly on pollutants and pollutant related issues.

Staff will coordinate closely with the CALFED Bay-Delta Program and the committees formed to guide implementation of the San Francisco Estuary Project's Comprehensive Conservation and Management Plan (CCMP). More staff time is needed to provide CALFED with adequate Regional Board input for evaluating, selecting and implementing strategies to reduce levels of pollutants in the Delta.

#### Marina Study

A number of marinas in the Delta require dredging for maintenance of their basin and for cleanup of past spills. Many small marinas have not conducted required maintenance dredging due to the regulatory process and high cost of sediment and water quality assessments. A program needs to be initiated to address permit streamlining, sediment quality, dredge material reuse, and financing for small marina dredging and disposal. This should be done with the active participation of local stakeholders. The program would involve conducting sediment quality surveys, developing management practices, developing a finance plan, preparing a general order, and conducting a cooperative monitoring program.